Method of forming a Seal Pattern for Liquid Crystal Display Device

Cross Reference

This application claims the benefit of Korean Patent Application No.1999-0036786, filed on September 1, 1999, under 35 U.S.C. § 119, the entirety of which is hereby incorporated by reference.

Background of the invention

Field of the invention

The present invention relates to a liquid crystal display (LCD) device, and more particularly, to a seal pattern and the same method in manufacturing the liquid crystal display device.

Description of Related Art

A typical LCD device comprises a LCD panel having upper and lower substrates spaced apart from and opposite to each other with a liquid crystal layer interposed therebetween. The upper substrate includes common electrodes, and the lower substrate includes switching elements such as thin film transistors (TFTs) and pixel electrodes.

In a brief explanation about the manufacturing process of a liquid crystal cell comprised in the liquid crystal panel, the common electrodes and the pixel electrodes are respectively formed over the upper and lower substrates, a seal pattern is formed over the lower substrate, the upper and lower substrates are aligned spaced apart from each other so that the common electrodes of the upper substrate and the pixel electrodes of the lower substrate are opposite to each other, the liquid crystal is injected into the gap therebetween through an injection hole, the injection hole is sealed, and finally, polarizing films are respectively attached to each outer surface of the upper and lower substrates. The amount of light passing through the liquid crystal cell is controlled by

electric field formed by the pixel and common electrodes, and characters or images are displayed due to the light shutter effect.

Compared with the thin film transistor or color filter manufacturing process, the liquid crystal cell manufacturing process barely has repeated steps. The total process is approximately divided into an orientation film forming process, a cell gap forming process, and a cell cutting process for a desired size.

Referring to FIG. 1, the typical liquid crystal cell manufacturing process is explained in detail.

As shown in FIG. 1, the first step is to form an array of the thin film transistors and the corresponding pixel electrodes over the lower substrate.

The second step is to form the orientation film over the lower substrate by uniformly depositing a polymer thin film over the lower substrate and uniformly rubbing the polymer thin film with a fabric.

The rubbing process means to rub the surface of the polymer thin film in a proper direction with the fabric so as to decide the orientation direction of the liquid crystal. A typical orientation film uses an organic thin film such as a polyimide thin film.

The third step is to print the seal pattern over upper substrate.

Due to the seal pattern, after attaching the upper and lower substrates, a spacing for interposing the liquid crystal is formed, and the interposed liquid crystal doesn't leak out of the liquid crystal cell. A thermosetting plastic and a screen-print technology are conventionally used for the seal pattern.

The fourth step is to scatter spacers over the lower substrate.

The spacers have a definite size in order to maintain a precise and uniform spacing between the upper and lower substrates. Accordingly, the spacers are scattered

throughout the lower substrate with a uniform density via a wet spray method of spraying the spacers mixed with an alcohol or a dry spray method of spraying only the spacers.

Further, the dry spray method is divided into a static electric spray method using static electricity and a non-electric spray method using a pressure of gas, and since the static electricity it harmful to the liquid crystal, the non-electric spray method is widely used.

After the process of scattering spacers, in the fifth step, the upper substrate having the color filters and the lower substrate having the thin film transistor array are aligned and attached with each other.

An aligning margin, which is less than a few micrometers, does an important role in the aligning and assembling process. If the two substrates are aligned and attached beyond the aligning margin, light leaks away so that the liquid crystal cell doesn't make a desired display quality.

In the sixth step, the liquid crystal cell fabricated through the step 1 to 5 for interposing the liquid crystal is cut into unit cell. Conventionally in the early stage, the liquid crystal is injected into the spacing between the upper and lower substrates and cut into a plurality of unit cells. But, as the larger display area becomes applied, the spacing for the liquid crystal is cut into the unit cell before the liquid crystal is interposed, and the liquid crystal is respectively injected into the unit cell so as to form a plurality of the unit cells.

The process of cutting comprises a scribing process of forming cutting lines on the substrate with a diamond pen harder than the substrate made of glass, and a breaking process of cutting the substrate by force(or pressure) according to the cutting lines.

The seventh step is to inject the liquid crystal into the unit cell.

Since the unit cell has a few square centimeters in area and a few micrometers in gap size, a vacuum injection technology using the difference in pressure is effectively and widely used for.

Now, referring to Fig. 2, the screen-print method applied for the seal pattern process of the third step is explained.

The screen-print method is facilitated with a patterned screen 6 and a squeegee 8.

In order to interpose the liquid crystal without leakage, the seal pattern 2 is formed along and on the edge of a substrate 1; at one side of the edge, an injection hole 4 for injecting the liquid crystal is formed.

To form the seal pattern 2, a thermosetting plastic including the spacers for maintaining the gap between the two substrates is distributed on the substrate 1, and thereafter a solvent included in the sealant is evaporated for a leveling.

In forming the seal pattern, the uniformity in thickness and width of the sealant is a very important factor to maintain the uniform spacing (or gap) between the two substrates.

For the seal pattern 2, a thermosetting or an ultraviolet-setting epoxy resin and the like are conventionally employed. But, though the epoxy resin itself is not harmful to the liquid crystal, an amine in a thermohardening solvent decomposes the liquid crystal. Thus, when using the epoxy resin for the seal pattern 2, the sealant formed through the screen-print method is pre-baked sufficiently with a gradual change of a baking temperature.

Hereinafter, referring to Fig. 3, the seal pattern is explained in detail.

Conventionally, in order to supply an electric field for the liquid crystal, electrode pads are formed over the lower substrate having the thin film transistors; a voltage is supplied to the common electrodes of the upper substrate by the electrode pads through certain electric conductors formed on the lower substrate. At this point, for the electric conductors, a silver paste (named as a silver dot hereinafter) is applied.

As shown in Fig. 3, the silver dot 10 is formed on the outside of the seal pattern 2 in the opposite direction with respect to the display area A. Namely, the seal pattern 2 is formed along and on the substrate, and, around the silver dot, the seal pattern bends in a rectangular shape in order to bypass and surround the silver dot 10. Since, around the silver dot 10, the seal pattern 2 is protruded toward the display area A to a length L in the rectangular shape, spots occurs on the display area A of the liquid crystal display device due to the amine included in the seal pattern 2.

Though the above-mentioned screen-print method is most widely used for the seal pattern due to the superiority in convenience, the screen-print method may result in an error by a contact between the screen and the orientation film formed over the substrate, and is not effectively adopted to a larger substrate.

Further, in the screen-print method, after the sealant is formed on the whole patterned screen, the squeegee rubs the sealant so as to form the seal pattern. Since the sealant is formed on throughout the patterned screen, an over-waste of the sealant occurs.

To overcome the above-mentioned problem of the screen-print method, a dispenser-print method becomes gradually adopted.

Referring to Fig. 4, in the dispenser-print method, a dispenser 20 filled with the sealant and a table 100 where the substrate 1 is located is used. On operation, the

dispenser 20 moves over the table 100; forms the sealant according to an arrow direction so as to form the sealant pattern 2.

However, since the above-mentioned dispenser-print method has a poor quality in complicate printing, the conventional many-bent seal pattern 2 shown in Fig. 3 is difficult to acquire through the dispenser-print method.

SUMMARY OF THE INVENTION

In view of the foregoing and other problems of the conventional seal pattern and the same methods, it is an object of the present invention to provide a small-bent seal pattern in order to decrease spots on the display area of the liquid crystal display device.

Another object is to provide a less-bent seal pattern in order that the dispenser-print technology is adapted to the seal pattern.

Thus, to overcome the above-mentioned objects, the present invention provides, in a method of forming a seal pattern of a liquid crystal display panel having a liquid crystal layer comprising forming a common electrode on a first substrate, forming a plurality of conductive contact dots on the second substrate, forming a seal pattern along edges of the second substrate, said seal pattern having a plurality of triangular bent portions which is bent toward an inside of the second substrate, and forming the liquid crystal layer between first and second substrates.

The foregoing and other objectives of the present invention will become more apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since

various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which like reference numerals denote like parts, and in which:

Fig. 1 is a block diagram illustrating a typical manufacturing process for a liquid crystal cell;

Fig. 2 is a perspective view illustrating a seal pattern process with a screen-print method;

Fig. 3 is a plan view illustrating the seal pattern around a silver dot;

Fig. 4 is a perspective view illustrating a dispenser-print method for the seal pattern;

Fig. 5 is a plan view illustrating the seal pattern around the silver dot according to a first embodiment of the present invention;

Fig. 6 is an expanded plan view of "r1" of Fig. 5; and

Fig. 7 is a plan view illustrating the seal pattern around the silver dot according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF PREFFERED EMBODIMENTS

Referring now to the drawings, and more particularly to Fig. 5, a first embodiment of the present invention is described.

Fig. 5 illustrates the feature of a seal pattern 200 according to the first embodiment of the present invention.

As shown in Fig. 5, around a silver dot 10, the seal pattern 200 has an open-sided triangular bent portion in order to bypass and surround the silver dot 10 with a vertex opposite to the open-side. The vertex is protruded toward a display area "A". The triangular shape of the seal pattern 200 decreases the protruding portion of the seal pattern in comparison with the rectangular bent of the conventional seal pattern.

Further, the triangular shape of the seal pattern 200 decreases the number of bents so that a dispenser-print method of relatively poor printing quality is sufficiently applied for printing the seal pattern.

In the seal pattern 200 according to the first embodiment of the present invention, the triangular bent has a first vertex "r1", a second vertex "r2", and a third vertex "r3" of a rounded shape, which will be explained with Fig. 6. Unless, around the vertexes in the seal pattern, cuttings or line-opens occur during the dispenser printing.

More specifically, the distance "d" between the silver dot 10 and the third vertex "r3" protruded toward the display area "A" is preferably 0.1 to 1 millimeters(mm); the distance "ℓ" between the first and the second vertexes "r1" and "r2" is preferably 5 to 20 mm.

Fig. 6 illustrates an expansion of the first vertex "r1" having a round of turning radius "R". The turning radius "R" of the round of the vertex "r1" is preferably 0.5 to 5 mm. The turning radius in the first vertex "r1" is also applied to the second and third vertexes. Namely, the second and third vertexes also have the round.

However, the seal pattern according to the first embodiment of the present invention is not limited to the structure of the above-described triangular bent.

That is to say, referring to Fig. 7, as a modification of the first embodiment of the present invention, instead of the triangular bent portion, the seal pattern 200 has a circular or an elliptical bent portion surrounding the silver dot 10 with two rounded vertexes "r1" and "r2". The turning radius of the rounded vertexes "r1" and "r2" is also 0.5 to 5 mm like the vertexes of the triangular bent portion in Fig. 5.

As described above with reference to Figs 5 to 7, the triangular, circular, or elliptical bent of the seal pattern 200 according to the preferred embodiment decreases the display-area-penetrating portion of the seal pattern so as to minimize the spots on the display area around the silver dots.

Further, in comparison with the conventional rectangular bent portion, due to the decrease of the number and bent angle of bent points in the bent portion such as the vertexes, the dispenser-print method is applied for forming the seal pattern without declination in printing quality.

While the invention has been particularly shown and described with reference to the preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.